APPENDIX A

SAMPLING AND ANALYSIS PLAN
GROUNDWATER INVESTIGATION
DOWNTOWN MONTESANO
MONTESANO, WASHINGTON

MAY 2, 2005

FOR
WASHINGTON DEPARTMENT OF ECOLOGY

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) summarizes field procedures for sample collection and analytical protocols during groundwater investigation activities in downtown Montesano, Washington. This SAP will be used in conjunction with the Health and Safety Plan (HASP).

The location of the Project Area is indicated on the Vicinity Map, Figure 1. The purpose of the investigation is to advance approximately 35 to 40 direct-push borings at selected locations in downtown Montesano. The borings will be located approximately as shown on Figure 2. Groundwater investigation activities are described in detail in this SAP.

The purpose of this plan is to describe field activities, sampling equipment, sampling locations and procedures that will be used during groundwater investigation activities at the Project Area. This plan also identifies quality assurance/quality control (QA/QC) procedures that will be implemented during sampling activities.

Detailed descriptions of the field sampling procedures are provided in this document. Site conditions may make it necessary to modify these procedures. Any variations or modifications that become necessary during the groundwater investigation will be coordinated with the Washington Department of Ecology (Ecology) and other involved parties, as appropriate. Variations or modifications implemented during the groundwater investigation and the reason for the modification will be documented in the field records.

2.0 SITE DESCRIPTION

2.1 GENERAL

Montesano is located on Highway 12, approximately 10 miles east of Aberdeen, Washington. The downtown area is situated on the north side of a valley containing Smith Canal. The ground surface slopes gently to the south toward Smith Canal. Groundwater flow is reported to be generally southeast toward the waterway.

2.2 DOWNTOWN MONTESANO AREA HISTORY

Multiple service stations existed in the downtown Montesano area from the early 20th century until 1967, the time of the relocation of U.S. Highway 12 from along Pioneer Avenue to its present location just south of the downtown area. Many of the service stations closed around the time of the relocation of U.S. 12, with many USTs suspected of being left in place, possibly with product still in them.

In the late 1980s, the City of Montesano replaced its gravity-flow sanitary sewer system with a pressurized “step-up” system. The City’s old and new sewer systems, and the City’s storm-drainage system may be providing preferential pathways for petroleum-related contaminants to spread from downtown Montesano towards the canal to the south.

Multiple former service stations and other suspect properties are located within the Project Area as indicated on Figure 2. Sites with known releases include properties occupied by, or formerly occupied by Key Bank, Jackpot Station 392, Grays Harbor County Vehicle Maintenance Facility, Tony's Short Stop, Brumfield-Twidwell, Grays Harbor Grange, and two sites at the City of Montesano's Shop. Additional sites are suspected of having been former service stations and were candidates for additional research. The locations of the sites with known or suspected releases are shown on Figure 2.

2.3 CONTAMINANT DISTRIBUTION

Information at the Project Area regarding contaminant distribution is sporadic. Monitoring wells exist at the sites indicated in Section 2.2, and petroleum hydrocarbon contamination has been detected at some of the wells exceeding MTCA Method A cleanup levels. The purpose of the present investigation is to further characterize contaminant distribution throughout downtown Montesano.

3.0 CONCEPTUAL MODEL

3.1 GENERAL

This section presents an overview of a conceptual model that addresses the relationship between historical sources of petroleum hydrocarbons in downtown Montesano and the nature and extent of contaminants detected in the downtown area. The purpose of the conceptual model is to provide an historical context for use in evaluating and selecting sites requiring additional exploration

3.2 CONCEPTUAL MODEL

The conceptual model proposed for the site is that petroleum releases from numerous sites throughout downtown Montesano have resulted in contamination of soil and groundwater in the Project Area. Petroleum hydrocarbons released from leaking tanks and/or piping has resulted in multiple areas contaminated with some or all of the following: petroleum product as light non-aqueous phase fluids (LNAPL or free phase petroleum hydrocarbons); residual hydrocarbons contained in soil; and dissolved phase petroleum contaminants.

Contamination will be mobilized from soil into groundwater by rainwater infiltrating into site soils, or by seasonal changes in groundwater elevations which allow residual petroleum contamination in soil to dissolve into groundwater. Groundwater containing dissolved phase petroleum hydrocarbons would migrate generally in a southeast direction across the downtown area of Montesano. See Figure 3.

The direction and rate of the groundwater flow across the Project Area may be affected by current and abandoned sanitary sewer lines and other underground utility corridors. These underground corridors may serve as subsurface drains, collecting and changing the direction and rate of groundwater flow. The conceptual model envisions groundwater flow being collected by these subsurface corridors with some portion of the total groundwater flow from the site discharging along these corridors to Smith Canal.

3.3 DATA REVIEW SUMMARY AND IDENTIFIED DATA GAPS

The following subsections contain a summary of the geologic and hydrologic data applicable to this site, and provide a summary of the data gaps and explorations proposed to address these data gaps.

3.3.1 Geology And Groundwater

Based on our review, LNAPL is impacting the shallow, perched aquifer at the site. Site geology includes a surficial unit of loose, relatively permeable alluvium as great as 20 feet thick overlying a hard, relatively impermeable silt or clay unit of unknown thickness. Groundwater is approximately 8 to 18 feet below ground surface. Groundwater flow is generally southeast toward Smith Canal. The contaminants present at the various sites were likely released from leaking tanks and piping. Free phase contaminant mobility beyond the release area is likely limited due to the relatively flat groundwater gradient at the site. Dissolved phase contamination likely migrates downgradient of the site in the same direction as the regional groundwater flow direction unless it encounters local variations in hydraulic conductivity which would alter the direction and rate of regional groundwater flow. Contaminant plumes will typically widen as they migrate away from the source area as a result of diffusion and dispersion.

It is likely that groundwater flow is affected by the current and abandoned sanitary sewer system. Porous bedding material and discrete spaces between the piping and pipe backfill can act as a groundwater collection system. This can result in a depression in groundwater elevations along the piping alignment, localized flow reversals and/or flow direction changes immediately adjacent to the pipeline alignment, and preferential flow parallel to the alignment of the sewer lines. This interruption to the regional groundwater flow will potentially result in contaminant migration cross-gradient to the regional groundwater gradient, and in contaminant transport along and potentially within the abandoned sewer lines.

3.3.2 Data Gaps

Data gaps identified as part of our review included a general lack of information describing contaminant distribution in both soil and groundwater for sites in the northern portion of the downtown area. Suspected source areas exist generally upgradient of the abandoned sanitary sewer lines, but there is little to no information available that describes the potential migration of contaminants towards the sanitary sewer lines. In addition, some sites on the southern portion of the downtown area have insufficient information to appropriately describe contaminant and groundwater flow adjacent to the abandoned sanitary sewer line. Our site historical review did not indicate any previously unreported potential source areas.

Our review of existing site information identified 22 potential areas that likely require additional exploration to better describe groundwater flow and contaminant distribution in the downtown Montesano area. These areas of concern and the proposed exploration locations for this groundwater investigation are shown on Figure 2.

In general, proposed boring locations were chosen based on the location of the abandoned sanitary sewer system and direction of groundwater flow relative to each site. Where possible, boring locations were chosen at locations that bisect a line drawn from the site to the closest portion of the abandoned sanitary sewer system along the direction of groundwater flow (southeast). These locations are described below:

- John Milnot - 1 boring between site and old sewer.
- Grays Harbor County - 2 borings between site and MW-1.
- Secondary School - 2 borings between site and sewer.
- Police Department - 2 borings between building and sewer to west.
- Rinehart - 1 boring between building and sewer.

- Lumber - 2 borings (on east and south side of site).
- Allison's and Pinger's - 2 borings (one on either side of sewer).
- Telephone Utility - 2 borings between site and sewer.
- Whitney's and Key Bank - 3 borings (one SE corner of park, one between buildings, one south of Whitney's).
- Picco's - 1 boring between site and sewer.
- Pontiac Richfield - 1 boring between site and sewer.
- Boyer's Phillips - 1 boring NE corner Thriftway
- Mobile and Fire Dept.- 2 borings (one on either side of sewer).
- B-T - 1 boring near MW-2.
- Smith - 1 boring south side of site.
- Tony's - 1 boring north side of building.
- City Shop1 boring between site and sewer
- City of Mont. and Grange - 5-7 borings, to be determined.
- P.J.'s - 1 boring to south, between site and sewer.
- Union - 2 borings downgradient of old ASTs.
- Monte Square - 1 boring between site and sewer.
- Montesano Cardlock - 2 borings downgradient.

The purpose of this exploration program is to provide a better understanding of the groundwater flow and contaminant transport within the downtown Montesano area from multiple petroleum hydrocarbon sites. Other data gaps that exist, but that are beyond the scope of this exploration program include identifying upgradient extents of contamination at the various sites in the downtown area, and quantifying any potential transport of either free phase or dissolved phase petroleum hydrocarbons in the abandoned sanitary sewer lines and associated bedding materials. If necessary, exploration activities to more fully describe the limits of contamination and the potential for offsite transport of these contaminants may be addressed in a future work phases.

4.0 EXPLORATION AND SAMPLING PROCEDURES

4.1 GROUNDWATER INVESTIGATION

The groundwater investigation will consist of advancing approximately 36 direct-push borings at selected locations, as shown on Figure 2. The impacted zone is believed to be located in the upper zone of the shallow aquifer. Drilling and sampling activities are expected to consist of the following:

1. Advancing approximately 35 to 40 direct-push borings to depths of up to 25' below ground surface (bgs) throughout the Project Area. The boring locations should be considered approximate and may change depending on observations made as drilling activities proceed. Any variations or modifications that become prudent or necessary during the groundwater investigation will be coordinated with the Washington Department of Ecology (Ecology) and other involved parties, as appropriate. The borings will be continuously sampled.

2. Performing field-screening of soil from the borings. Field-screening techniques include, but are not limited to, water sheen-testing, headspace vapor testing (PID), and visual and olfactory observations for unusual colors or petroleum odors, respectively.
3. Collecting as many as two soil samples from each boring. The depth from which samples will be submitted for anlaysis will be based partially upon field-screening. Soil samples will be collected in 8-ounce jars appropriate for soil sampling and immediately placed in a cooler with ice. Samples will be labeled such that the boring number, sample number and sample depth will be apparent, for example: SP-1-2-12.5.
4. Collecting one groundwater sample from each boring after completion of drilling. Samples will be collected using "low-flow" technique, and will include collection of four HCl preserved (1 to 1) 40-mL VOAs. Groundwater samples will be placed in a cooler with ice. Non-preserved 1 L amber bottles will be available at the Site should observations indicate a necessity to collect 1 L samples.
5. Following proper chain-of-custody procedures and transferring groundwater samples to an on-site Ecology representative, who will submit groundwater samples to Manchester Laboratories, Inc. for analysis by NWTPH-Gx and BTEX (and NWTPH-Dx, as appropriate based on observations in the field).
6. Following proper chain-of-custody procedures and transferring soil samples to North Creek Analytical Laboratories, Inc. (NCA), in Bothel, Washington, for analysis by NWTPH-Gx, BTEX and NWTPH-Dx.

A representative from GeoEngineers will coordinate and observe the drilling activities. GeoEngineers will maintain a detailed log of soil and groundwater conditions encountered within each boring and map the location of each boring in the field. Soil will be classified in general accordance with American Society for Testing and Materials (ASTM) D 2488. The field screening results and soil classification will be recorded on the boring logs. Known site features will be used as references to map the locations of borings.

The sampling equipment will be cleaned prior to each sampling attempt with an Alconox wash, a tap water rinse, and a distilled water rinse.

4.2 FIELD SCREENING

Samples obtained from the borings will be field screened for indications of petroleum hydrocarbons. Field screening results will be recorded on the field logs. Field screening results will be used as a general guideline to evaluate possible contamination. The following screening methods will be used: 1) visual screening, 2) water sheen screening, and 3) headspace vapor screening. Visual screening and water sheen screening are qualitative methods; therefore, precision, accuracy and detection limits are not quantified for these methods. Headspace vapor screening is a semi-quantitative method; however, precision and accuracy will not be quantified for this method. Instrument accuracy and detection limits are described below. Field screening results are site- and location-specific. The results vary with temperature, moisture content, soil type and type of contaminant. Field screening will consist of the following:

Visual Screening. The soil will be observed for indications of petroleum impacts, including unusual color, stains, and/or odor indicative of possible contamination.

Water Sheen Screening. A portion of the soil sample will be placed in a pan containing distilled water. The water surface will be observed for signs of sheen. The following sheen classifications will be used for this project:

- No Sheen (NS) - No visible sheen on the water surface.
- Slight Sheen (SS) - Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly.
- Moderate Sheen (MS) - Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface.
- Heavy Sheen (HS) - Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen.

Headspace Vapor Screening. A portion of the soil sample will be placed in a plastic bag. Ambient air will be captured in the bag; the bag will be sealed, and then shaken gently to expose the soil to the air trapped in the bag. The bag will remain closed for approximately 5 minutes at ambient temperature before the headspace vapors are measured. Vapors present within the sample bag's headspace will be measured by inserting the probe of a combustible gas indicator (CGI) Bacharach TLV Sniffer or a photoionization detector (PID) Photovac MicroTIP Model MP100 in a small opening in the bag. The maximum measured value will be recorded on the field log for each sample.

The monitoring instruments will be calibrated, as described in the following section. The CGI measures the concentration of combustible vapors in parts per million (ppm) and is calibrated to hexane. The CGI quantifies combustible gas concentrations in the range between 100 ppm and 10,000 ppm, with an accuracy of 100 ppm in this application. The PID measures the concentration of organic vapors ionizable by a 10.6 electron volt (eV) lamp in ppm. The PID will be calibrated to 100 ppm isobutylene. The PID quantifies organic vapor concentrations in the range between 0.1 ppm and 2,000 ppm (isobutylene equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm.

5.0 FIELD EQUIPMENT CALIBRATION PROCEDURES

Field equipment requiring calibration will be calibrated to known standards in accordance with manufacturers' recommended schedules and procedures for each instrument. Calibration checks of the vapor measurement equipment will be conducted daily, and the instruments will be recalibrated if required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

6.0 INVESTIGATION-DERIVED WASTE

Investigation-derived wastes along with petroleum-contaminated materials and purge water from the borings/wells will be placed in labeled drums at the sewage treatment facility south of Montesano. Wastes will be characterized and disposed as appropriate. All disposal activities will be documented and tracked.

6.1 SAMPLE HANDLING

The following procedures will be used at all times when collecting soil samples during the groundwater investigation activities.

Neoprene, nitrile or vinyl gloves will be worn when handling soil samples. New disposable gloves will be used for each sample.

All soil samples will be collected with a stainless steel spoon and placed into a stainless steel bowl. Sufficient sample volume will be obtained for the laboratory to complete the method-specific quality control analyses on a laboratory-batch basis. Samples selected for chemical analysis will be placed in laboratory-supplied containers.

Sample labels will be completed for each sample following the procedures provided in this section. Samples will be stored in a cooler with ice until they are delivered to the on-site Ecology representative or to NCA. Standard chain-of-custody procedures will be followed for all samples collected.

6.2 DECONTAMINATION PROCEDURES

6.2 1 General

The objectives of decontamination procedures are to minimize the potential for cross-contamination between exploration locations and between individual samples within a specific exploration, to prevent contamination from leaving the sampling site by way of equipment or personnel, and to prevent exposure of field personnel to contaminated materials. This section discusses general decontamination procedures.

6.2.2 Personnel

Personnel decontamination procedures depend on the level of protection specified for a given activity. The HASP identifies the appropriate level of protection for each type of fieldwork involved in this project, as well as appropriate decontamination procedures.

6.2.3 Sampling Equipment

Decontamination procedures are designed to remove trace-level contaminants from sampling equipment to prevent cross-contamination of samples.

Sampling equipment, including stainless steel sampling tools and soil sampling equipment will be decontaminated prior to and after each sampling attempt by washing with nonphosphate detergent solution (Alconox and potable tap water), rinsing with potable tap water and final rinsing with distilled water.

6.3 DOCUMENTATION OF FIELD ACTIVITIES

6.3.1 General

Daily field activities, including observations and field procedures, will be recorded on appropriate forms. The original field forms will be maintained in GeoEngineers' office files. Copies of the completed forms will be maintained in a sequentially numbered field file for reference during field activities. Indelible ink will be used, unless prohibited by weather. Photographic documentation of field activities will be performed as appropriate.

6.3.2 Soil Sample Designation And Labeling

Each soil sample collected during the groundwater investigation activities will be identified by a unique sample designation. The sample designation will be included on the soil sample label. The designation also will be included with the corresponding sample information on the appropriate boring log. The following designation system will be used for this project.

Soil Sample Designation Example: SP-1-2-12.5

Where:

SP-1 = Groundwater investigation boring number

2 = Sample number

12.5 = Approximate sample depth in feet below the ground surface

The label "TB" will be used for field trip blanks. "ES" will be used for equipment rinseate blanks for soil sampling. "Dup" will be used for sample duplicates.

Sample labels will be completed in indelible ink. Sample labels will include the following information:

- GeoEngineers' job number
- Sample designation
- Date of sample collection (month/day/year)
- Time of sample collection (hours:minutes)

6.3.4 Groundwater Sample Designation And Labeling

Groundwater samples collected during the groundwater investigation activities will be identified by a unique sample designation. The sample designation will be included on all water sample labels. The designation also will be included on the appropriate groundwater collection form.

The following designation system will be used for this project.

Water Sample Designation Example: SPW-1

Where:

SPW-1=Groundwater investigation boring number

1=Sample number

The label "TB" will be used for field trip blanks. "ES" will be used for equipment rinseate blanks for soil sampling. "Dup" will be used for sample duplicates.

Sample labels will be completed in indelible ink. Sample labels will include the following information:

- GeoEngineers' job number

- Sample designation
- Date of sample collection (month/day/year)
- Time of sample collection (hours:minutes)

A groundwater sample collection form will be filled out during collection of each groundwater sample. Information to be recorded on the form includes:

7.0 QUALITY ASSURANCE/QUALITY CONTROL

7.1 QUALITY ASSURANCE OBJECTIVES

The general quality assurance (QA) objectives for this project are to develop and implement procedures for obtaining and evaluating data of a specified quality that can be used to assess site conditions and risks. Field QA procedures to be followed include collecting equipment blanks and duplicate samples, and completing all appropriate sample documentation. Measurement data should have an appropriate degree of accuracy and reproducibility; samples collected should be representative of actual field conditions, and samples should be collected and analyzed using proper chain-of-custody procedures.

7.2 FIELD QA/QC PROCEDURES

Field QA/QC procedures to be followed include collecting equipment rinseate, trip blanks and duplicate samples, and completing all appropriate sample documentation. Field QA samples will represent at least 5 percent of the total number of samples obtained during this IA.

7.2.1 Equipment Blanks

Equipment blanks will be obtained at a minimum frequency of 5 percent of the samples collected during the investigation. Equipment blanks are used to identify contamination that may be transferred from sampling equipment to the samples. Equipment blanks are prepared by pouring distilled water into the decontaminated sampling apparatus and subsequently pouring it into a prepared sample container.

The equipment rinseate blanks for soil sampling will be labeled with “ES” sample identifiers as described earlier under “Sample Designation and Labeling” and delivered to the laboratory with the normal shipment of samples.

7.2.2 Duplicate Samples

Duplicate soil samples will be analyzed at a frequency of at least 5 percent of the samples analyzed.

Duplicate samples are used to evaluate the precision and accuracy of overall sampling and analytical methods. Duplicate samples will be prepared by collecting twice the normal quantity of a sample at a given location. The soil will be mixed thoroughly and split between two separate jars at the time of collection. The duplicate sample(s) will be labeled with a “Duplicate” sample identifier as described earlier under “Sample Designation and Labeling” and delivered to the laboratory with the normal shipment of samples.

7.2.3 Trip Blanks

The analytical results of field trip blanks will be reviewed to evaluate the possibility for contamination resulting from the laboratory-prepared sample containers or the sample transport containers. Trip blanks will be analyzed at a frequency of one for each shipment of samples. The trip blanks will be labeled with a "TB" sample identifier as described earlier under "Sample Designation and Labeling" and delivered to the laboratory with the normal shipment of samples.

7.2 4 Sample Preservation, Holding Times And Containers

Samples will be kept in a cooler with ice before and during transport to the laboratory. The sampling, extraction and analysis dates will be reviewed to confirm that extraction and analyses were completed within the recommended holding times, as specified by EPA protocol. Appropriate data qualifiers will be noted if holding times are exceeded or containers do not contain the appropriate sample preservation.

7.2.5 Sample Shipment And Custody

Chain-of-custody procedures will be used to track the possession of the samples from the time they are collected in the field through delivery to the on-site Ecology representative. Each time the samples change hands, both the sender and receiver will sign and date the chain-of-custody record form.

7.2.6 Analytical Procedures

EPA standard analytical methods are specified in Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, 3rd Edition, EPA-SW846, September 1986. Washington analytical methods for petroleum hydrocarbons are specified in the Washington Model Toxics Control Act (MTCA) regulations, as outlined in the Washington Administrative Code (WAC) 173-340.

7.3 Review Of Field And Laboratory QA/QC Data

The sample data, field and laboratory QA/QC results will be evaluated for acceptability with respect to the groundwater investigation data quality objectives (DQOs). Each group of samples will be compared with the DQOs and evaluated using data validation guidelines contained in the following documents: "Guidance Document for the Assessment of RCRA Environmental Data Quality," draft dated 1988; "National Functional Guidelines for Organic Data Review," draft dated 1991; and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," dated 1988. To accomplish data evaluation, the criteria listed in the following subsections will be assessed.

7.4 Precision, Accuracy And Completeness

7.4.1 Precision

Precision is a measure of data variability. Variability can be attributed to sampling activities and/or chemical analysis. Relative percent difference (RPD) is used to assess the precision of the sampling and analytical method and is calculated as follows:

$$RPD=100[(Xs - Xd)/(Xs + Xd)]/2$$

where

RPD=relative percent difference

Xs=sample analytical result

Xd=duplicate sample analytical result

7.4.2 Accuracy

Accuracy is a measure of the error between chemical analytical results and the true sample concentrations. Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of spiked samples. The accuracy will be presented as percent recovery and will be calculated as follows:

PR = 100(Xss - Xs)/T

where

PR = percent recovery

Xss = spike sample analytical result

Xs = sample analytical result

T = known spike concentration

7.4.3 Completeness

Completeness is evaluated to assess whether a sufficient amount of valid data is obtained. Completeness is described as the ratio of acceptable measurements to the total planned measurements. Completeness is calculated as follows:

C=(Number of samples having acceptable data)/

(total number of samples analyzed) x 100%

where

C=completeness

7.5 REPORTING, DOCUMENTATION, DATA REDUCTION AND CORRECTIVE ACTION

Upon receipt of each laboratory data package, data will be evaluated against the criteria outlined in the previous sections. Any deviation from the established criteria will be noted, and the data will be qualified, as appropriate. A review and discussion of analytical data QA/QC will be submitted in a report to be attached to the groundwater investigation report. Data validation procedures for all samples will include checking the following (when appropriate).

Holding times

Detection limits

Field equipment rinseate blanks

Trip blanks

Laboratory blanks

Laboratory matrix spikes

Laboratory matrix spike duplicates

Laboratory blank spikes

Laboratory blank spike duplicates

Surrogate recoveries

If significant quality assurance problems are encountered, appropriate corrective action as determined by GeoEngineers' project manager, Ecology and/or the analytical laboratory will be implemented as appropriate. All corrective action will be defensible, and the corrected data will be qualified.

8.0 REFERENCES

Model Toxics Control Act (MTCA) Cleanup Regulations, *Washington Administrative Code, Chapter 173-340.* Washington State Department of Ecology.

EPA. October 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final*. OSWER Directive 9355.3-01. EPA/540/G-89/004.

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